

Dedek, Nancy

From: Boyle, Fred
Sent: Monday, April 15, 2002 11:27 AM
To: Skursha, David; Zalar, Frank V.; Lvovich, Vadim
Subject: Temperature Compensation-Draft 1

Hopefully our Wednesday meeting will answer the questions sent to Vadim, which will help me get over-the-hump of deciding how much detail to put into the EIS patent. In the meantime, I am also working on a "Temperature Compensating" patent, and have written the attached first couple of sections. I send this simply as "food for thought", both in terms of what is claimed ("Summary of Invention" section is a simple outline for the claims) and what figures (data) are needed to demonstrate the invention. Maybe we can spend a few moments reviewing this on Wednesday.

-Fred



Temperature
Compensation Draft..

TITLE

METHOD FOR TEMPERATURE COMPENSATING SENSOR DATA WHEN MONITORING QUALITY/CONDITION OF FLUIDS ON-LINE

ABSTRACT OF THE DISCLOSURE

A method for compensating data for temperature variations from sensors monitoring the quality and/or condition of fluids while in use in transportation and industrial equipment. The method includes curve fitting sensor data versus temperature from a first fluid temperature threshold to a second fluid temperature threshold if fluid temperature rise is greater than a preset rate, typically occurring after equipment start-up, and using those determined curves to compensate sensor outputs during equipment operation until the next time the curve-fit criteria are met. This method allows sensor data to be used for accurate on-line fluid quality and condition determination.

BACKGROUND OF THE INVENTION

[001] The present invention relates to a method that allows on-line monitoring initial quality and chemical condition of a fluid that varies in temperature while in use. More specifically, this invention relates to a cost-effective method for compensating data from sensors, that are used to measure temperature-sensitive fluid-properties, which allow diagnoses of initial fluid quality and/or of fluid condition changes, for examples chemical changes, depletion of performance additives, or contamination with unwanted liquids or solids, during equipment operation.

[002] Fluids are a critical component for the proper operation of many types of equipment. For examples: lubricant is needed for an internal combustion engine to efficiently provide power over a long service life; high quality fuel is needed for proper engine operation with minimal emissions; and metal working fluid is needed in machining equipment for rapid metal removal and maximum tool life. For optimum performance, a fluid must initially be of the proper quality for the application, that is, the fluid must have an appropriate base fluid and proper performance additives, for example dispersants and detergents. Also for equipment optimum performance, fluid condition must remain within determined limits. Examples of chemical changes that can occur to a fluid during use are oxidation of the base fluid, depletion of performance additives, and build-up of contaminants. While most device owners and process operators depend on suppliers to provide proper quality fluids and on regular fluid maintenance to maintain proper fluid condition, these dependencies do not protect against accidental fluid substitution, or catastrophic fluid failure. In addition, owners or

operators may be able to reduce maintenance cost if fluid maintenance were to occur only when needed based on monitored fluid condition.

[003] Hence, owners and operators desire an on-line fluid monitoring of a fluid's initial quality and continuing chemical condition while in use. Achieving appropriate on-line fluid monitoring is difficult for a variety of sensor and data interpretation related issues. The fluid monitoring task is even more difficult in applications where fluid temperature varies as a function of equipment internal and external operating parameters. In general, measurable fluid properties vary as a complex function of temperature and quality/condition. Separating the temperature related property changes from quality/condition related property changes is essential for proper fluid diagnosis.

[004] One approach for separating temperature and quality/condition effects is by controlling the fluid temperature. One or more sensors can be mounted in a temperature controlled manifold or chamber, or individual sensors can have heating and/or cooling elements mounted at- or adjacent to- the volume or sensor components of the sensor where the fluid measurement is taken. The heating/cooling elements maintain the temperature of the fluid in the proximity of the sensor. A limitation of this approach to separating temperature and quality/condition fluid property changes is the added cost and complexity to accomplish the desired of the fluid monitoring. The added cost is not only due to the additional hardware required, but also the cost of the power required to maintain fluid temperature.

[005] Another approach to separating temperature related effects from fluid property measurements is to collect data during use only when the fluid temperature is within a prescribed limited range. Indeed, some fluid monitoring algorithms, e.g. the Delphi algorithm, collect data at specific temperatures as the fluid temperature increases immediately after each time the equipment, containing the fluid, begins operation. In any case, using this approach the fluid is not being monitored wherever the fluid temperature is not at the specific temperatures or is outside the prescribed temperature range. Not having continuous monitoring limits the usefulness of on-line monitoring.

[006] Another approach to separating temperature related effects from fluid property measurements is to "correct" the data for temperature variations by using formulae or "look-up" tables. This approach typically assumes that all fluids, current and future, that can be used in the equipment have the same or very similar temperature related dependences, and that the temperature related dependences do not change as fluid condition changes during use. In general, different fluids can have different temperature related dependences, and temperature related dependences do change as fluid condition changes. Hence, this approach can have significant error.

SUMMARY OF THE INVENTION

[007] The present invention overcomes the limitation of previous approaches to separate temperature related effects from fluid property measurements by determining the temperature dependence of the individually monitored fluid properties each time fluid temperature increases from a first fluid-temperature threshold to a second fluid-temperature at a rate greater than a threshold rate, typically during equipment start-up and, and using the so determined temperature dependences to correct sensor outputs for temperature variations until the next time that the temperature dependences are determined or until the equipment's used fluid is replaced with fresh fluid.

[008] One feature of the invention is that no costly or complex hardware is needed to control temperature in order to separate temperature related effects from fluid property measurements.

[009] Another feature of the invention is that the fluid is being monitored continuously once the fluid temperature is above the first temperature threshold.

[010] Another feature of the invention is that temperature corrections change as fluid type and/or fluid condition changes.

[011] Another feature of the invention is that changes in the temperature dependence of the individually monitored fluid properties can be used to determine if a fluid change or addition was made to the equipment, and to determine the quality of the new or added fluid.

[012] The foregoing and other aspects and features of the invention will become apparent from the following description made with reference to the figures.

BRIEF DESCRIPTION OF THE FIGURES

[013] FIG. 1 is a schematic illustration of the electrical impedance of the same engine oil that is fresh (unused), approximately one-half useful life remaining, and in need of replacement as a function of temperature.

[014] FIG. 2 is a schematic illustration of the viscosity of the same engine oil that is fresh (unused), approximately one-half useful life remaining, and in need of replacement as a function of temperature.

[015] FIG. 3 is a schematic illustration of typical engine oil temperature variations in passenger car internal combustion engine.

[016] FIG. 4 is a flow chart of an invention embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[017] The invention relates to a cost-effective method for compensating data from sensors, used to measure temperature-sensitive fluid-properties, to allow diagnoses of initial

fluid quality and/or of fluid condition changes. For the purposes of illustration, the following schematics and embodiment are shown and described.

[018] Figures 1 and 2 are schematic illustrations of the temperature dependence electrical impedance and viscosity respectively of an oil for an internal combustion engine at three times in the life of the oil. Curve "A" in each figure is taken when the oil was fresh, that is before the oil was placed in the engine. Curve "B" in each figure is taken after the oil was in the engine sufficient time for the oil to be at approximately the mid-point of its useful life as determined by _____. Curve "C" in each figure is taken after the oil is at the end of its useful life as determined by the same standards as above, and is in need of replacement.

[019] Referring to Fig. 1, as the oil ages ...

**PETITION FOR REVIVAL OF AN APPLICATION FOR PATENT
ABANDONED UNINTENTIONALLY UNDER 37 CFR 1.137(b)**

Docket Number (Optional)

3206

First named inventor: David B. Skursha

Application No.: 10/700,207

Art Unit: 2863

Filed: 11/03/2003

Examiner: Michael P. Nghiem

Title: On-Line Monitoring that Compensates for a Fluid's Temperature Dependence

Attention: Office of Petitions

Mail Stop Petition

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

FAX (571) 273-8300

NOTE: If information or assistance is needed in completing this form, please contact Petitions Information at (571) 272-3282.

The above-identified application became abandoned for failure to file a timely and proper reply to a notice or action by the United States Patent and Trademark Office. The date of abandonment is the day after the expiration date of the period set for reply in the office notice or action plus an extensions of time actually obtained.

APPLICANT HEREBY PETITIONS FOR REVIVAL OF THIS APPLICATION

NOTE: A grantable petition requires the following items:

- (1) Petition fee;
- (2) Reply and/or issue fee;
- (3) Terminal disclaimer with disclaimer fee - required for all utility and plant applications filed before June 8, 1995; and for all design applications; and
- (4) Statement that the entire delay was unintentional.

1. Petition fee

☐ Small entity-fee \$ _____ (37 CFR 1.17(m)). Applicant claims small entity status. See 37 CFR 1.27.

☒ Other than small entity - fee \$ 1,500.00 (37 CFR 1.17(m))

2. Reply and/or fee

A. The reply and/or fee to the above-noted Office action in the form of Response (identify type of reply):

- ☐ has been filed previously on _____.
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B. The issue fee and publication fee (if applicable) of \$ _____.

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[Page 1 of 2]

This collection of information is required by 37 CFR 1.137(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 10 hour to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop Petition, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

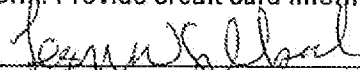
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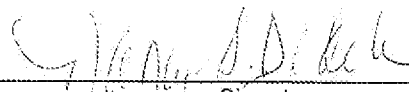
☒ Since this utility/plant application was filed on or after June 8, 1995, no terminal disclaimer is required.☐ A terminal disclaimer (and disclaimer fee (37 CFR 1.20(d)) of \$ 65.00 for a small entity or \$ 130.00 for other than a small entity) disclaiming the required period of time is enclosed herewith (see PTO/SB/63).

4. STATEMENT: The entire delay in filing the required reply from the due date for the required reply until the filing of a grantable petition under 37 CFR 1.137(b) was unintentional. [NOTE: The United States Patent and Trademark Office may require additional information if there is a question as to whether either the abandonment or the delay in filing a petition under 37 CFR 1.137(b) was unintentional (MPEP 711.03(c), subsections (III)(C) and (D)).]

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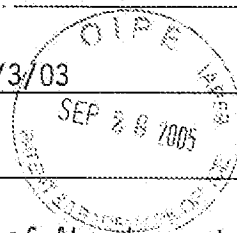
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SignatureNancy S. Dedek
Typed or printed name of person signing certificate

Docket No. 3206 Date Mailed: 9/26/05
Serial No. 10/700,207 Filed: 11/3/03
Inventors(s) Skursha et al.
This acknowledges receipt of Response to Notice of Abandonment (in
duplicate), copy of items (A) an (B) of Declaration under
37 CFR 1.131, Petition for Revival for Patent Abandoned
Unintentionally and copy of complete specification-clean version
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Serial No. 10/700,207 Filed: 11/3/03
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